- Office hour changes

Q29: 1, 3, 5, 6, 7, 10, 11, 12, 13, 15, 14, 18

Lsq residual

Elim matrices

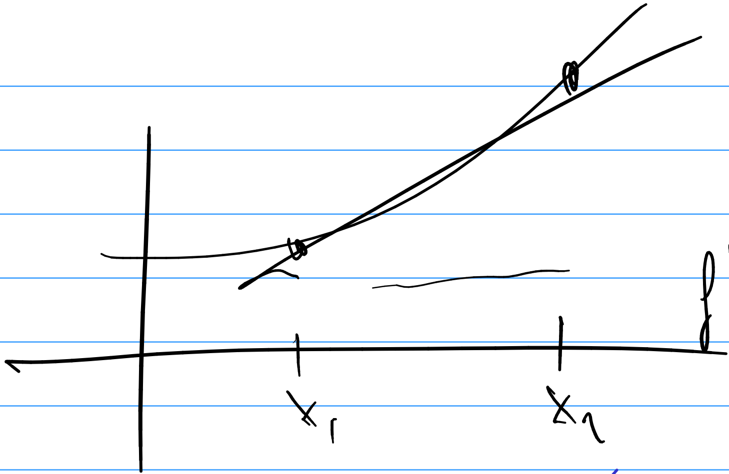
Nonlinear: Newton's method

Monte Carlo

SVD

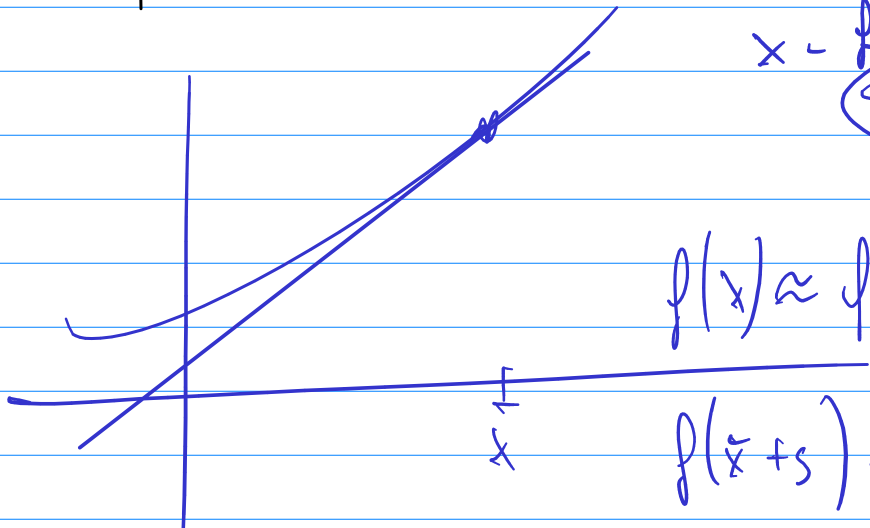
Expected value from example

↳ GSS, GD



$$f'(x) \approx \frac{f(x_2) - f(x_1)}{x_2 - x_1}$$

$$x - \frac{f(x)}{f'(x)}$$



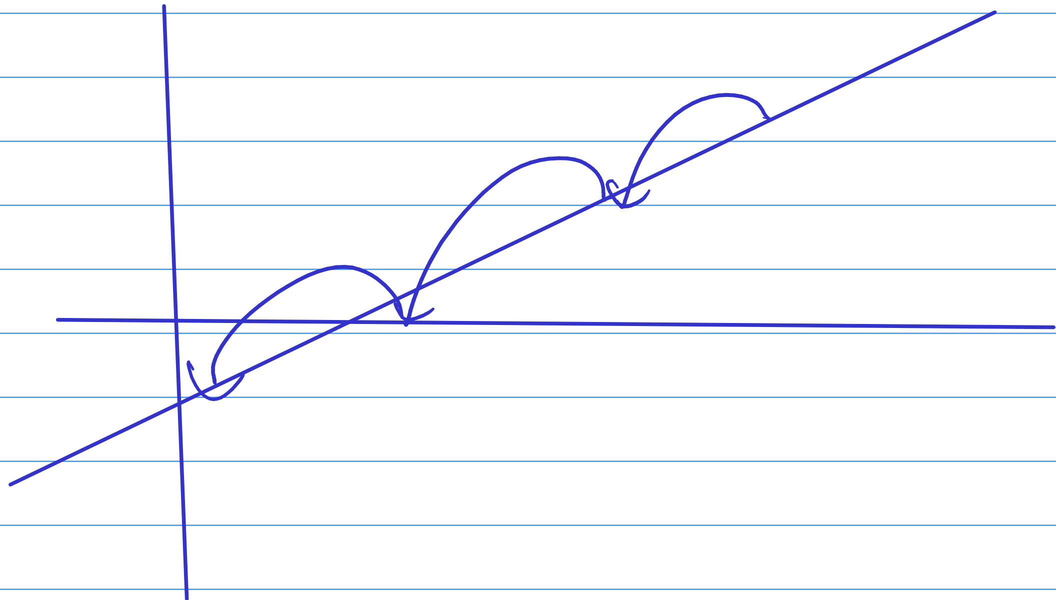
$$f(x) \approx f(\bar{x}) + f'(\bar{x}) \cdot (x - \bar{x})$$

$$f(\bar{x} + s) \approx f(\bar{x}) + f'(\bar{x})\, s$$

$$f(x) = x^2 - 3$$

$$f(x) \approx f(\bar{x}) + f'(\bar{x})(x - \bar{x})$$

$$f(2) + f'(2) \cdot (x - 2)$$



$$\|A\|_1 = \max_{\rightarrow} \sum_{\downarrow} |a_{ij}|$$

$$\|A\|_\infty = \sum_{\rightarrow} \max_{\downarrow} |a_{ij}|$$

$$A = U \Sigma V^T$$

orth

$$\|Q\tilde{x}\|_2 = \|\tilde{x}\|_2$$

$$\|A\|_2 \leq \|U\|_2 \|\Sigma\|_2 \|V^T\|_2$$

$$= 1 \cdot \sigma_1 \cdot 1$$

$1 . \_\_\_ \; \_\_ \; \_\_ \; \_\_ \; \_\_ \; . \; 2^{-\text{gigant}}$

$$\begin{pmatrix} 16 \cdot 4 \cdot x^3 & 16 \cdot 4 y^3 & 4z^3 \\ 2x & 2y & 2z \\ 3x^2 & -1 & 0 \end{pmatrix}$$

$$E[X] = \sum_{x} x \cdot p(x)$$

Golden Section Search

- Would like a method like bisection, but for optimization.
  In general: No invariant that can be preserved.
  Need *extra assumption.*

Demo: Golden Section Search Proportions

Steepest Descent

- Given a scalar function $f : \mathbb{R}^n \to \mathbb{R}$ at a point $\boldsymbol{x}$, which way is down?

Demo: Steepest Descent

Newton's method (*n*D)

- What does Newton's method look like in n dimensions?

Demo: Newton's method in n dimensions

Demo: Nelder-Mead Method

Nonlinear Least Squares/Gauss-Newton

- What if the f to be minimized is actually a 2-norm?

$$f(\boldsymbol{x}) = \|\boldsymbol{r}(\boldsymbol{x})\|_2, \qquad \boldsymbol{r}(\boldsymbol{x}) = \boldsymbol{y} - \boldsymbol{f}(\boldsymbol{x})$$

Demo: Gauss-Newton